

at five years although a slight increase in CMC1 scores was observed. Patterns of involvement were also similar as witnessed by high intra-class coefficients for DIP (0.88), PIP (0.79), CMC (0.73) and aggregate scores (0.87) at five years. On side by side comparison of photographs, 4 subjects (2.8%) had probable worsening and 4 had (2.8%) definite worsening in the IP joints, and in the CMC1 joints 14 (9.8%) had probable and 10 (7.0%) definite worsening. Progress in the CMC1 joints was more apparent in females.

**Conclusions:** At this age, there is little change in IP joint osteoarthritis and photographic scores do not detect changes after 5 years, although side by side comparison detects occasional worsening. There appears to be more progress of HOA in the CMC1 joints in this age group, but hand position in photographs is very important in estimating OA in these joints and changes in hand posture due to aging and other neuromuscular conditions may exaggerate apparent worsening.

This study confirms the robustness of the photographic method showing high reproducibility at five year intervals. Even in this age group, progress of HOA can be determined on side by side comparison of photographs.

#### 415

##### LOAD RESPONSE OF KNEE CARTILAGE T2 IN PATIENTS WITH MENISCUS DISORDER: EVALUATION USING LOADING IN SITU MRI

T. Nishii, T. Shiomi, O. Tamura, H. Tanaka, K. Nakata, K. Murase, Y. Yamazaki, H. Yoshikawa, N. Sugano  
Osaka Univ. Med. Sch., Osaka, Japan

**Purpose:** The normal meniscus was assumed to distribute the load transmission over the entire surface of the articular cartilage, and meniscus disorder may lead to abnormal load distribution in response to load-bearing, resulting in high prevalence of osteoarthritis progression. Therefore, evaluation of intra-articular biomechanical condition after meniscus injury is important to estimate risk of subsequent progression of osteoarthritis and to decide appropriate treatment methods. Recent studies showed that responsiveness of articular cartilage to compressive loading by T2 value may indicate pressure distribution on the cartilage, via evaluation of dynamic changes in the collagenous architecture or water influx or efflux. We have developed a loading apparatus to apply axial load to the knee joint during MR imaging in order to simulate physiological load-bearing condition while standing. Our objectives were to examine clinical feasibility of cartilage T2 with use of loading in situ MR imaging, for evaluation of abnormal pressure distribution in patients with knee meniscus disorder.

**Methods:** Thirteen patients with knee injuries (13 knees) and 10 asymptomatic normal volunteers (10 knees) were imaged on a 3.0 T GE MRI scanner using a 8-channel knee phased array coil. The mean age of the patients and volunteers were 34 and 32 years, respectively. Among 13 patients, 9 patients had either or both of the medial and lateral meniscus abnormalities and the other 4 patients had ACL or PCL injury without meniscus disorder, which were confirmed by arthroscopy. During MR imaging, the participants was laid on a custom-made loading apparatus, which had a pulley system linked to a sliding foot plate. The shoulders of the participants were strapped tightly, and 50% of the body weight was applied via the foot plate, when loading. On unloading and loading conditions, sagittal T2 maps of the medial and lateral femoro-tibial joints were obtained from multi-echo spin echo sequence with fat-suppression (TR, 1500 ms; 8 echoes between 10.0 ms and 80.0 ms; field of view, 12 cm; matrix, 384×256). On each of medial and lateral mid-sagittal image, the cartilages at the weight-bearing ranging anterior and posterior margins of the meniscus were divided into 3 sections with equal length, and each section was further divided into deep and superficial layers with equal thickness, using a custom-made software (Fig. 1). Change of T2 values by loading in each ROI was compared between patients and normal volunteers, and between joint compartments with and without meniscus tear among patients, using the nonparametric Mann-Whitney U test.

**Results:** On unloading condition, there was no significant difference of T2 at each ROI between patients and volunteers, except AD of the medial femoral cartilage in which T2 of the patients was significantly higher ( $p=0.01$ ). By loading, T2 was likely to decrease at each zone, however, there was no significant difference of T2 change at each ROI between patients and volunteers. Among 13 patients, meniscus tear was noted in 5 knees at the medial side and in 7 knees at the lateral side. In the medial side, T2 at AS of the femoral and tibial cartilages decreased significantly larger in knees without meniscus tear than knees with meniscus tear (Femoral cartilage:  $-13.3\%$  vs  $-0.3\%$ ,  $p<0.05$ ; Tibial cartilage:  $-8.2\%$  vs  $+4.7\%$ ,  $p<0.05$ )

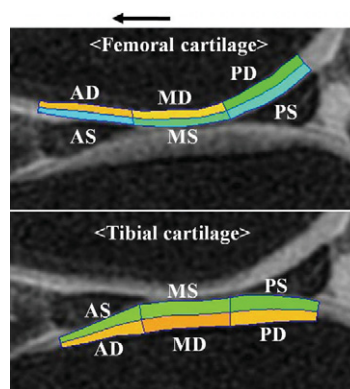


Figure 1. Definition of ROIs at the femoral and tibial cartilage.

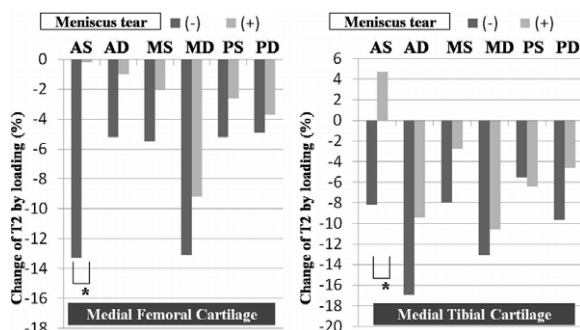


Figure 2. T2 change by loading in knees with and without meniscus disorder (\* $p<0.05$ ).

(Fig 2). In the lateral side, there was no significant difference of T2 decrease between knees with and without meniscus tear.

**Conclusions:** Significantly smaller decrease of T2 in knees with meniscus tear may reflect location-specific load transmission failure associated with the meniscus tear. In this context, T2 evaluation under loading conditions can be expected to provide biomechanical assessment of pathological conditions with respect to localized stress concentration in the cartilage of patients with knee injuries.

#### 416

##### THE NATURAL HISTORY OF OA ASSOCIATED BMLS IN THE OAI PROGRESSOR COHORT

S.W. Mclure<sup>1</sup>, M.A. Bowes<sup>2</sup>, C.B. Wolstenholme<sup>2</sup>, G.R. Vincent<sup>2</sup>, S. Williams<sup>1</sup>, P.G. Conaghan<sup>1</sup>

<sup>1</sup>Univ. of Leeds, Leeds, United Kingdom; <sup>2</sup>Imorphics Ltd, Manchester, United Kingdom

**Purpose:** The natural history of osteoarthritis (OA) related bone marrow lesions (BML) is poorly understood. Although it is clear that BMLs are not static, studies have reported conflicting results concerning their turnover and location. Semi-quantitative evaluation has been unable to study the spatial and temporal distribution of BMLs. This study employed a novel statistical model to precisely locate the BMLs within the subchondral bone and generate detailed anatomically relevant maps to track their change in size over time.

**Methods:** A cohort of 88 subjects was generated from the Osteoarthritis Initiative (OAI) progression groups O.B.1 (baseline) and 1.B.1 (12-month follow up visit). Subjects had K-L scores of 2 or 3; medial JSN > lateral JSN, medial osteophytes and  $\geq 1^\circ$  of varus mal-alignment. OA related BMLs were defined as ill-delineated regions of hyperintensity in the subchondral bone, excluding the region adjacent to ligament attachment sites on Turbo Spin Echo magnetic resonance images (MRIs). The slice-by-slice, subvoxel delineation of the lesions across the paired images was blinded to time-point but not to subject using EndPoint software (Imorphics, Manchester, UK). Study reproducibility was determined using a Bland Altman test and the measurement error defined as the smallest detectable difference (95% level of agreement). BML depth with respect to the adjacent bone surface was calculated using an adapted method previously utilised for articular cartilage thickness measurement. A statistical bone model was